

## CHAPTER 3

### ARCHITECTURAL AND STRUCTURAL SYSTEMS

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#### 3-1. Architectural and structural systems design criteria

The basic design criteria consist of protecting the command center of the C4ISR facility from an internal attack while limiting the impact of the event on the rest of the building space. The intent is to prevent bomb fragments (projectiles) as well as airborne chemical, biological, and possibly radiological agents from a terrorist attack from spreading throughout the building and to limit their mission impact on the zone in which the event occurs. Therefore, the approach for designing a generic building type such as this (see figures 2-1 and 2-2) is as follows:

- a. Divide the building into zones that are sealed off from one another to prevent the spread of any potential contaminants. With each zone being totally self-contained, the damage or infiltration created by a bomb or hazardous agent does not affect an adjacent zone.
- b. Locate the command center at the center of the building, with support spaces around it. This buffers this space in the case of a terrorist attack, whether by explosion, ballistics, or CBR agent release.
- c. Segregate the mission support spaces into separate zones, each with its own independent mechanical systems, electrical service, toilet facilities, and exit ways (including exit stairways).
- d. Connect each zone to other zones via a perimeter corridor for exiting and access functions. These corridors do not need to be separate zones. The perimeter corridor system requires only minimal mechanical and electrical services to meet life safety requirements.

#### 3-2. Applicable building codes and standards

The building should be designed and constructed to meet the codes and standards required by the authority having jurisdiction (AHJ) at the specific location where the building is to be constructed. The building should meet the building codes for seismic construction as required at that locale or as directed by the AHJ.

- a. In many cases, specific construction types and materials for exterior construction, and in some cases for interior construction, may be required at a particular location. The building should conform to those individual requirements as necessary. Many bases, posts, and governmental agencies have their own architectural design guidelines, which should be followed as closely as possible in the design of the building.
- b. In addition, the building must meet the following codes and standards:
  - (1) Codes
    - (a) National Fire Protection Association (NFPA) 70, National Electrical Code (NEC)
    - (b) Most current approved building code, Uniform Building Code (UBC), International Building Code (IBC), or building code required by the AHJ
    - (c) NFPA 101, Life Safety Code®

(d) NFPA 13, Installation of Sprinkler Systems

(2) Standards

(a) Unified Facilities Criteria (UFC) 1-200-01 Design: General Building Requirements.

(b) Unified Facilities Criteria (UFC) 4-010-01, DoD Minimum Antiterrorism Standards for Buildings

(c) Unified Facilities Criteria (UFC) 4-010-10, DoD Minimum Antiterrorism Standoff Distances for Buildings

(d) Americans with Disabilities Act (ADA) Standards for Accessible Design

(e) Uniform Federal Accessibility Standards (UFAS)

### 3-3. Compartmentalization

To compartmentalize the C4ISR facility to prevent the transfer or migration of a fire, an explosion, or an airborne CBR agent, the walls dividing these zones are the first line of defense for the building interior.

a. Therefore, these zone demarcation walls should be constructed as follows:

(1) Extend the zone demarcation walls from the floor to the underside of the structure above.

(2) Construct these walls of blast-resistant materials. (See paragraph 3-5, Materials of Construction, for discussion of those materials.) Seal the walls at all joints, along with all mechanical ductwork, electrical conduit, miscellaneous piping, and other penetrations through these walls, to form a protective barrier.

(3) Use windowless demarcation walls to provide a level of protection against the spread of projectiles from a terrorist attack or other act of sabotage between zones.

(4) Use doors with a blast-resistant rating at all zone demarcation walls.

b. Within each zone, the interior doors, walls, and other structural features may be of standard construction unless directed otherwise by the AHJ. Blast-resistant doors are not required within a zone; the intent is not to require blast-resistant construction throughout the entire building.

### 3-4. Egress and circulation paths

Egress and circulation paths must take into consideration the Americans with Disabilities Act along with consideration of life safety.

a. C4ISR facilities must meet ADA requirements for accessibility as mandated by the federal government. These requirements include access for persons with disabilities throughout the building and accessible means of egress. The need for accessibility applies not only to persons in wheelchairs but also to people with other disabilities, such as those who use crutches or who have sight, hearing, or mental impairments. The example two-story facility shown in figures 2-1 and 2-2 takes into account the requirements for building accessibility. Note that the compartmentalization of the LVD concept requires accessibility to each zone independently.

b. Life safety is another important aspect of any building and must be taken into account for C4ISR facilities. The example facility shown in figures 2-1 and 2-2 provides a corridor system around the perimeter of the building for access to and egress from all portions of the building spaces. Additionally, corridors are provided to the command center itself for access and egress. These corridors serve as the exit enclosure or exit way for the building and are therefore of fire-rated construction. They are not considered separate zones in the same context as the mission support spaces and the command center. The exit corridors must be provided for life safety purposes; however, they also provide separation in a fire-related event, protection during a terrorist attack, and an additional buffer between mission support spaces to limit potential damage from an event in another space.

c. The example facility shown in figures 2-1 and 2-2 also includes stairways, which are required in multi-story facilities for exiting purposes. The following are considerations regarding stairways:

(1) To maintain the segregation of the LVD concept, each zone should have stairs that are connected to an exterior exit or enclosed exit way leading to an exterior exit from the building. Including a stairway in each zone further limits the spread of contaminants—whether chemical, biological, or radiological—to other parts of the building.

(2) The number of stairways should be determined by the requirements set forth in NFPA 101 or the building code required by the AHJ at that specific location. Those requirements include, but are not limited to, travel distance to the stairways and occupant load of the floor plate.

(3) In the event of an emergency, stairways may also provide an area of refuge for persons in wheelchairs. The size of this refuge area should be determined from the relevant building code or the AHJ.

(4) Personal protective equipment (PPE) and other emergency response provisions such as first aid stations, fire extinguishers, and standpipes should be established individually for each zone.

### **3-5. Materials of construction**

This document is not intended to provide a list of building materials or building systems to use in construction nor to provide equivalent blast requirements of various building materials to use in the application of the LVD concept. There are many DoD documents that provide information about the minimum AT/FP standards for buildings. These documents should be consulted when the design basis threat level for the building has been determined. Only then can the design and engineering professionals design the building to withstand the corresponding event.

a. To determine and specify building material strengths, flammability, and barrier characteristics, it is necessary to consider the design basis threat and the geographic location of the C4ISR facility, which could have a major effect on the construction type and available construction materials.

b. The following guidelines apply to materials for the zone demarcation barriers of a C4ISR facility:

(1) Doors and frames should be of blast-resistant construction. Ratings for blast-resistant doors are to be determined based on the design basis threat for the building.

(2) Glass, when used, should be of laminated construction and used in small amounts. The amount of glass used should be directly correlated to the design basis threat for the building.